1

2 Watermarking a Page Description Language File

3 **Field of the Invention:**

4 The present invention relates to computer technology and more particularly to digital

5 watermarking technology.

6

7 **Background:**

8 A printed page may include graphics, text and images. The graphics, text and

9 images on a page are positioned at specific places on the page to provide a desired

10 effect. A page description language (PDL) is generally used to provide instructions

11 to a printer concerning how the graphics, text and images should be positioned on a

12 page.

13

14 In most situations, an "interpreter" in the printer accepts the instructions provided by

15 the PDL along with the necessary graphic, text and image objects. The interpreter

16 generates appropriate raster image files to position of the ink dots which will form

17 the desired printed page. PostScript ™ which was developed by Adobe Systems

18 Corporation is the most widely used PDL; however, there are many other PDLs that

19 have been defined.

20

21 The page layout program PageMaker™ marketed by Adobe Systems Corporation is

22 in widespread use to generate PostScript files. While the PageMaker program is in

23 widespread use there are also are other somewhat similar programs such as those

24 marketed under the trademarks "Quark Express" and "InDesign".

25

26 A number of available interpreters take PostScript files and generate the raster

27 images required by printers. One such interpreter is marketed by Adobe Systems.

28 Another such interpreter is marketed under the trademark "PhonenixPage" by

29 Xionics Document Technologies. Still another PostScript interpreter called

1 "Ghostscript™" is freely available at various internet sites under the "Aladdin

2 Ghostscript Free Public License".

3

4 Programs that can insert digital watermarks into images are in widespread use. For

5 example the widely used image editing program "Photoshop™" includes a

6 mechanism for inserting a watermark into an image.

7

8 **Summary of the Present Invention:**

9 The present invention provides a method and system for watermarking a file which

10 is in a PDL such as PostScript. The present invention can be used to either

11 watermark a PDL file and then generate a watermarked PDL file or the present

12 invention can be part of the interpreter in a printer which takes a file in a PDL and

13 which then generates watermarked raster images which are printed.

14

15 The present invention includes an "interpreter" which generates raster images from

16 the PDL file. The raster images are then watermarked using conventional

17 watermarking techniques. Next the raster images are either printed (if the

18 interpreter is part of a printer) or the raster images are combined into a new PDL

19 file.

20

21 The specific embodiment shown relates to a PostScript file; however, it should be

22 understood that the invention can also be applied to files in other page description

23 languages. PostScript is merely used as an example.

24

25 **Brief Description of Drawings:**

26 Figure 1 is an overall flow diagram of the process.

27 Figure 2 is a flow diagram of the operation that take place in the watermark

28   interpreter.

29 Figure 3 is a block diagram of a PostScript Interpreter.

30 Figure 4 shows a mask which defines areas in an image.

1　　Figure 5 is a block diagram of an interpreter.

2

3　　**Description of Preferred Embodiment:**

4　　The preferred embodiment of the present invention provides a method and system

5　　for watermarking a PostScript file. Due to its construction and format, a file in a

6　　PDL such as PostScript can not be watermarked using the conventional

7　　watermarking programs such as that which is part of the Photoshop program. The

8　　preferred embodiment of the present invention is directed to watermarking a

9　　PostScript file; however; it should be understood that the invention can also be used

10　　to watermark files in various other PDL languages.

11

12　　The preferred embodiment utilizes elements from the Ghostscript interpreter. The

13　　source code for the Ghostscript interpreter is freely available at various internet web

14　　sites under the "Aladdin Ghostscript Free Public License". It should be understood

15　　that while the preferred embodiment utilizes the Ghostscript interpreter, the

16　　invention can be used with other PostScript interpreters and with other PDLs.

17

18　　The overall operation of the invention is illustrated in Figure 1. The process begins

19　　as indicated by block 101. A page layout program such as PageMaker is used to

20　　generate a PostScript file 103. The page layout program combines text 101A,

21　　images 101B and graphics 101C with appropriate instructions and codes, to

22　　produce the desired lay out of a page. Such page layout is conventional and it

23　　results in a PostScript file 103. The PostScript file 103 is passed to a watermarking

24　　interpreter 105 which add an appropriate watermark and then generates a new

25　　watermarked PostScript file 106. The details of the watermarking interpreter are

26　　described below. Finally PostScript file 106 is provided to a printer which prints the

27　　desired page.

28

29　　Figure 2 illustrates the operations performed by the watermarking interpreter 105.

30　　First the watermarking interpreter generates the appropriate raster images as

1   indicated by block 201. A conventional interpreter mechanism, such as that

2   available in the Ghostscript interpreter can be used to generate the raster image

3   files. A block diagram of such a mechanism is provided in Figure 5. Next, as

4   indicated by blocks 203 and 204, the areas in each raster image indicated by mask

5   401 (mask 401 is explained later) are watermarked. That is, the bits in the area

6   indicated by mask 401 are watermarked using conventional watermarking

7   technology. Next as indicated by block 205, the watermarked raster images are

8   combined into a new postscript file 207. That is, a simple compiler program adds

9   simple PostScript commands and combines the four raster images into a news

10   PostScript file 207. Creating such a Postscript file from the four raster images uses

11   conventional technology known in the art. Finally the PostScript file 207 is sent to a

12   printer which prints the PostScript file using conventional technology. Naturally the

13   file 207 may be stored on conventional storage mechanisms and electronically

14   transmitted if desired prior to printing.

15

16   As indicated in Figure 3, a printed page may contain a combination of images , text

17   and graphics. The page shown in Figure 3 includes images 302, 303, and 304, text

18   305 and graphics 306 and 307. It should be understood that the page illustrated is

19   merely an example and a page may have a simple or complicated arrangement of

20   text, images and graphics.

21

22   In order to avoid creating visual artifacts, it may be desirable to only watermark

23   selected portions of a page. A mask such as that shown in Figure 4 may be used.

24   In the example shown the mask 401 indicates the areas where a watermarking

25   signal should be applied. It should be understood that mask 401 is not a physical

26   object. It is merely a designation of the areas in a page where a watermark should

27   be applied. That is, areas where the pixels should be "tweaked" in order to apply a

28   watermark to the page. Instead of showing areas where the page should be

29   watermarked, the mask could alternatively show areas that should not be

1　watermarked. The area selected for watermarking are generally areas where the

2　application of a watermark signal will not materially degrade the image.

3

4　The raster image files are watermarked using conventional watermarking

5　technology that specifies how various bits should be changed in order to embed a

6　watermark. For example co-pending application SN 09/694,465 entitled

7　"Watermarking an Image in Color Plane Separations and reading such watermarks"

8　describes technology which could be used to watermark the raster images. The

9　content of application 09/694,465 is hereby incorporated herein by reference.

10

11　Prior to changing any bit in one of the raster images, the mask 401 is interrogated to

12　determine if the particular bit is in a location where it is desired to apply a

13　watermark. If the particular bit is located in the area of mask 401 indicating that the

14　area should be watermarked, the bit is changed, otherwise the bit is not changed.

15

16　A block diagram of the watermarking interpreter 105 is shown in Figure 5. The

17　watermarking interpreter 105 utilizes the well known components of the Ghostscript

18　interpreter. Further details of the Gohstscript interpreter can be found in sources

19　such as the "Ghostscript User Manual" by Thomas Merz (1996-97) which is widely

20　available on the world wide web.

21

22　As indicated in Figure 5 the interpreter takes the graphics 501, the fonts 502, the

23　vectors 503 and the device controls 504 (there also may be other elements) and

24　creates a display list 509. The display list provides information for an image

25　pipeline 511 and a page pipeline 512, The output of pipelines 511 and 512 is the

26　raster image files. In the example illustrated the raster images are CMYK images,

27　515C, 5165M, 515Y and 515K. Naturally in other environments these could be

28　other types of raster images. The publically available source code for the Gostscript

29　interpreter provides a mechanism for implementing the elements shown in Figure 5.

30

1   Each of the raster images 515C to 516K are then watermarked as indicated in

2   Figure 2. This can be done as shown in co-pending application SN 09/694,465

3   entitled "Watermarking an Image in Color Plane Separations and reading such

4   watermarks" which in incorporated herein by reference. These images are only

5   watermarked in the areas indicated by mask 401. The result is four watermarked

6   raster images.

7

8   In the preferred embodiment described above, the four watermarked raster images

9   are combined into a PostScript file as indicated in Figure 1. In an alternate

10   embodiment, the watermarking interpreter is embedded in, and is part of a particular

11   printer. In such an embodiment, the watermarked raster images would be sent

12   directly to the printing mechanism as is conventional. Embedding an interpreter in a

13   printers is conventional. In such a case after the raster images are watermarked,

14   they would be directly printed rather than being combined into another PostScript

15   file.

16

17   It is also noted that in some situations only one raster image is generated and in

18   some situation three, four or more raster images are generated. For example if the

19   colors are RGB, three raster images are generated. In the situations where the

20   printing utilizes hexachrome (i.e. spot colors) there would be six raster images. The

21   term set is used to mean the number of raster images generated for the particular

22   application.

23

24   While the invention has been shown and described with respect to various preferred

25   embodiments, it should be understood that that various changes and alterations can

26   be made without departing from the spirit and scope of the invention. The scope of

27   the invention is limited only by the appended claims.

28

29   I claim: